CYTOLOGICAL INVESTIGATIONS ON THE ASTERACEAE-GENUS *BLUMEA* AND RELATED GENERA *LAGGERA* AND *NANOTHAMNUS*[1]

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(*With three plates*)

Key words: *Blumea* spp., *Laggera* spp., *Nanothamnus* sp., cytological treatment

Meiotic chromosome numbers are reported for 20 species of *Blumea,* 3 species of *Laggera* and 1 species of *Nanothamnus* occurring in India. The counts have been made from a total of 250 specimens, with full voucher information for each. New data is compared with all previous reports for the species of these three genera. Some conclusions are drawn regarding the affinities of the species.

Introduction

The genus *Blumea* belongs to the Tribe Inuleae, Sub-tribe Plucheinae, of the family Asteraceae and forms a dominant element of the "weed floras" of SE. Asia. Many species of the genus are second growth plants occupying disturbed areas along roadsides, railway lines and forest paths, and in clearings, thickets and waste fields. A few species are shrubby and grow as undergrowth plants of evergreen forests at high altitudes. All species are tropical and restricted to the Old World.

Laggera is also a weedy genus distributed in India, tropical Asia and Africa. *Nanothamnus* is endemic, monotypic and restricted to a few localities in western peninsular India.

On the basis of previous taxonomic investigations (Randeria 1960), the genus *Blumea* has been divided into 7 sections containing a total of 49 species over the entire geographical range. These species have been delimited on the basis of traditional characters of habit and inflorescence type, as well as on the anatomy of leaf epidermal cells, position of stomata, and type of trichomes. This was necessary because the species of the genus are very closely inter-related and often subtly intergrade into one another through hybridization, back crossing and apomixis. The pattern of evolution is possibly a highly complex, three-dimensional reticulum. In general, *Blumea* appears to be a young genus rapidly evolving at the present time and also extending its geographic range. Because of these various problems, additional evidence from cytological investigations was needed to support the data from external and internal morphology.

It was with this view in mind that the present study was undertaken. The cytological investigations have been limited only to the Indian species of *Blumea, Laggera* and *Nanothamnus* because of the ready availability of the material. Of the total of 49 species of *Blumea,* 23 occur in India and they are distributed among 6 of the 7 sections of the genus. Material could only be collected for 19 of these species, and they have been investigated for their chromosome numbers. In addition, chromosome counts have also been obtained for *Laggera aurita* Sch.-Bip. and *Nanothamnus sericeus* T. Thoms.

Materials and Methods

Fresh materials of the various species of *Blumea, Laggera* and *Nanothamnus* were collected and included both capitula with unopened flower buds and mature achenes. The capitula were fixed in the field whereas the achenes were preserved for subsequent germination in the laboratory. The chromosome counts listed in this study were, however, exclusively made from meiotic divisions in the pollen mother cells because of the inability of getting the seeds to germinate even under varied conditions.

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Collections were made over three successive growing seasons and in all some 250 specimens have been obtained. All these were subjected to cytological inquiry. Four other species of *Blumea,* namely, *Blumea aromatica* DC., *Blumea barbata* DC., *Blumea bifoliata* (Linn.) DC., and *Blumea napifolia* DC., have been reported as occurring in India. Material for the same could not be collected and hence, these have been excluded from the present cytological treatment.

Young capitula of various sizes with unopened florets were collected from the plant and immediately fixed in the field in Newcomer's solution (Newcomer 1953). The same specimen was later pressed and mounted for the herbarium.

The fixed material was brought to the laboratory and left to stand for at least 24 hours in order to allow for thorough penetration by the fixative. The material was then transferred to vials containing propionocarmine and stained for 24 hours. After this, the anthers were dissected out in a drop of stain on a slide and squashed by digital pressure. Slides were made permanent by immersing them in a solution containing one part glacial acetic acid and one part N-butyl alcohol till the slide and coverslip could be separated. Then, the slide and coverslip with the adhering material were passed through pure N-butyl alcohol for dehydration before mounting in Canada Balsam.

Karyotype drawings were made with a camera lucida from both temporary and permanent mounts; all illustrations are drawn to the same scale. Photographs have been made from permanent slides. Voucher specimens with karyotype diagrams and permanent slides have been deposited in the Blatter Herbarium, St. Xavier's College, Bombay.

All the Indian species of *Blumea* investigated cytologically are arranged under their respective sections. The treatment of each species includes the chromosome number and a list of specimens. Diagrams and photomicrographs of meiotic figures are provided for each species. The species of *Laggera* and *Nanothamnus* are similarly described.

Cytological History of Tribe Inuleae — Sub-tribe Plucheinae: The Plucheinae is one of the 8 subtribes of the Tribe Inuleae and includes a total of 18 genera (Hoffmann 1897). Ten genera have very restricted distribution and of these, 5 are endemic as well as monotypic. The remaining 8 genera have few to many species each and are widely distributed and abundant where they occur.

There is not much information regarding the cytology of the Plucheinae. Chromosome numbers have been reported for only 5 genera and, in each case, only a few species have been worked out.

The 5 genera are: *Pluchea* (8 species): 2n = 20 or 30; *Pterocaulon* (1 species) : 2n = 20 ; *Blumea* (14 species) : 2n = 18, 20, or 22; *Laggera* (4 species): 2n = 20 or 22; *Sphaeranthus* (2 species) :2n = 20.

With regard to the other subtribes of the Inuleae, the following chromosome numbers have been reported:

Subtribe Tarchonanthinae — 3 genera — no reports.

Subtribe Filagininae — 12 genera.

Filago germanica: 2n = 28.

Subtribe Gnaphalinae — 49 genera

Antenaria (7 species): 2n = 28, 42, 56 or 84; *Leontopodium* (4 species): 2n = 20, 24 or 52; *Anaphalis* (3 species) : 2n = 14 or 28; *Gnaphalium* (6 species): 2n = 14, 28, or 56; *Helichrysum* (1 species): 2n = 28.

Subtribe Angianthinae — 11 genera

Caesulia axillaris Roxb.: 2n = 14.

Subtribe Relhaninae — 14 genera — no reports.

Subtribe Athrixinae — 7 genera — no reports.

Subtribe Inulinae — 22 genera

Inula (7 species): 2n = 16 or 32;

Perralderia (1 species): 2n = 18.

From the above rather inadequate data, it is difficult to draw any conclusions. However, it appears in general that 3 subtribes of the Inuleae, namely, Filagininae, Gnaphalinae and Angianthinae have a base number of n = 7. The Inulinae possibly have a base number of n = 8 or 9.

The existing records of the 5 genera of the Plucheinae, as well as this present study on the chromosome counts of *Blumea, Laggera* and *Nanothamnus* point towards a base number of n = 9,

10 or 11 for the subtribe.

The Inuleae thus appear to be a diverse and possibly polyphyletic group with the commonest basic chromosome numbers ranging from n = 7 to n = 11. Polyploid series exist for all these numbers though aneuploidy is not common.

These results conform with the work done on the chromosome numbers of other tribes of the Asteraceae. Extensive studies have been carried out on the Astereae and n = 9 is regarded as a basic number for that group with a second mode centering around n = 4 or 5. In general, the woody habit is primitive and the low chromosome number is a specialised condition correlated with dry habitat (Raven *et al.* 1960, 1964).

The Heleniceae have the commonest basic numbers n = 6, 7, or 8, and the chromosome numbers coincide with morphological variability. It is not possible to arrive at a single basic number for this tribe (Raven and Kyhos 1961).

A base number of n = 10 has been proposed for the Senecioneae (Ornduff *et al.* 1963) and of n = 9 for the Ambrosineae (Payne *et al.* 1964).

Cytological Treatment:

A. **Blumea** DC.

The genus *Blumea* has been divided into 7 sections and 49 species (Randeria 1960). Of these, 6 sections including 23 species are represented in India. Section Sagittatae occurs only in China and Indochina.

Section I. Semivestitae

Total number of species — 8.

Species found in India — 3.

Species belonging to this section are predominantly shrubby. The capitula are paniculate with the outer phyllaries ovate to oblong. The receptacle is pubescent to fimbriate. Achenes are ribbed.

1. **Blumea procera** DC., Prodr. 5: 445. 1836.

Chromosome number: n = 10

Specimens examined: Assam, Shillong: *ARD 83, ARD 238, ARD 240, ARD 248* (BLAT).

2. **Blumea riparia** (B1.) DC., Prodr. 5: 444. 1836.

var. *riparia* Randeria, Blumea 10 (1): 214. 1960.

Conyza riparia Blume, Bijdr. 899. 1826, *non* H.B.K.

Chromosome number: n = 10 (Previously reported - n = 9, Bhattarai, Gorkhali and Saiju from Nepal).

Specimens examined: Assam, Shillong: *ARD 84, ARD 239, ARD 250* (BLAT).

3. **Blumea lanceolaria** (Roxb.) Druce, Rep. Bot. Exch. Club Brit. Isles 4:609. 1917.

Conyza lanceolaria Roxb., Fl. Ind. 3: 432. 1832.

Chromosome number: n = 10 (Previously reported - n = 10, R.C. Gupta and B.S. Gill from Madhya Pradesh).

Specimens examined: N. Kanara, Castlerock: *ARD 109-112*; Jog Falls: *ARD 142, 143*; Sirsi: *ARD 146, 147, ARD 214* (BLAT).

Section II. Macrophyllae

Total number of species - 10.

Species found in India - 3.

Species belonging to this section range from herbaceous to shrubby. The capitula are arranged in panicles and the outer phyllaries are linear. The receptacle may be glabrous, pilose or fimbrillate. Achenes are ribbed.

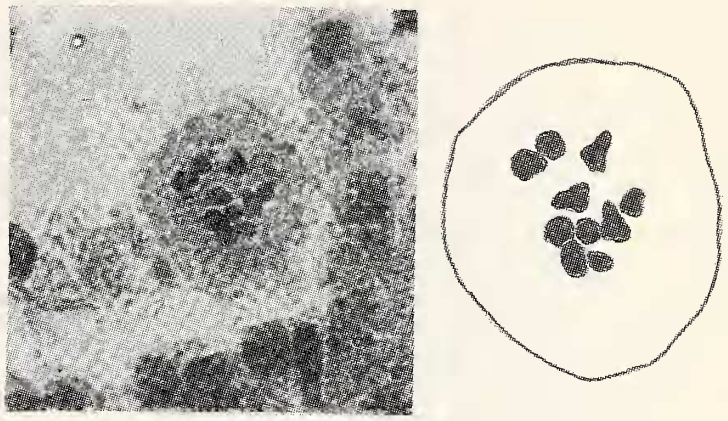
4. **Blumea aromatica** DC., Prodr. 5: 446. 1836.

Chromosome number: This species was not examined cytologically as no material of the same was collected (Previously reported - 2n = 18, Malla, Bhattarai *et al.* from Nepal; 2n = 18, Ching-I Peng and Chien-Chang Hsu from Taiwan).

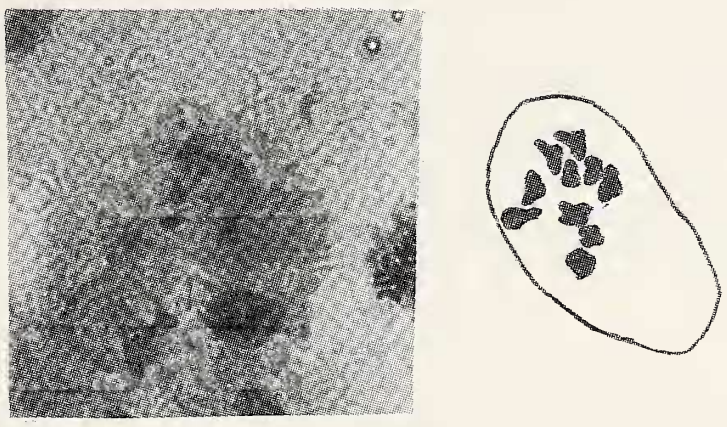
5. **Blumea densiflora** DC., Prodr. 5: 446. 1836.

Chromosome number: No chromosome count could be made for this species because young flower buds could not be collected. The specimens

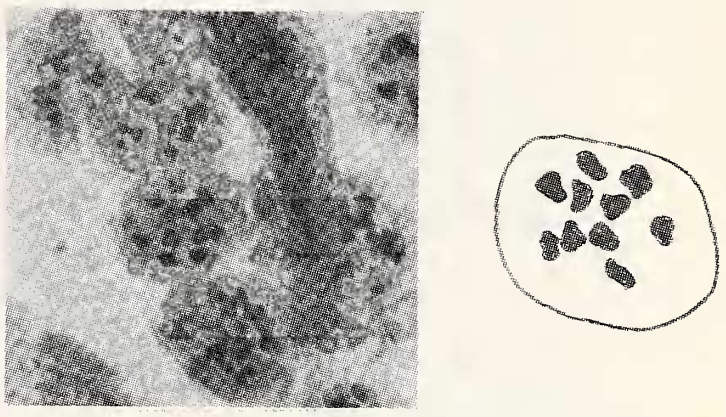
1. Blumea procera DC.
n = 10 (ARD 83)



2. Blumea riparia (Bl.) DC.
n = 10 (ARD 84)

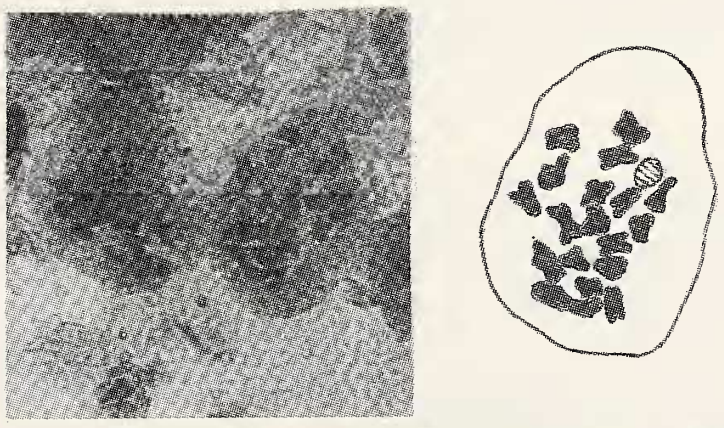


3. Blumea lanceolaria (Roxb.) Druce
n = 10 (ARD 110)

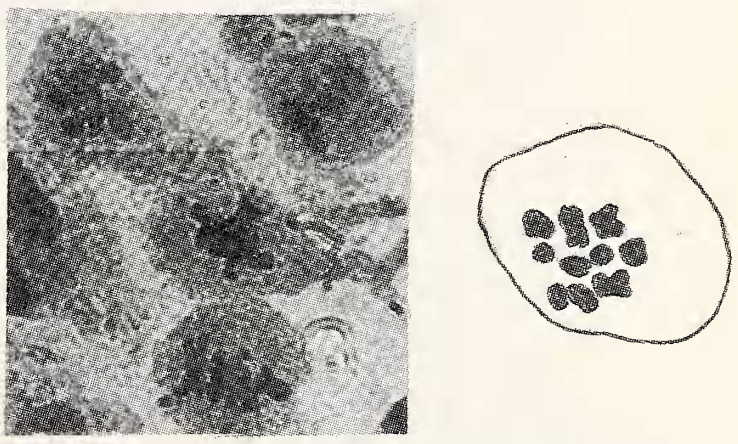


4. Blumea balsamifera (Linn.) DC.
n = 10 (ARD 228)

25 μ



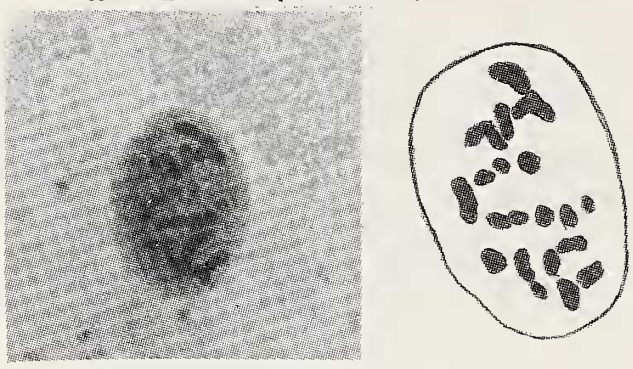
5. Blumea hieraciifolia (D.Don) DC.
var. macrostachya (DC.) Hook.f.
n = 18 (ARD 86)



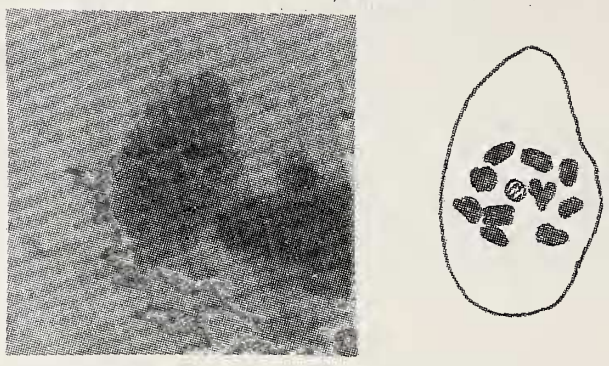
6. Blumea clarkei Hook.f.
n = 10 (ARD 151)

Photomicrographs and Karyotype Drawings.
1-3. Section Semivestitae; 4. Section Macrophyllae; 5-6. Section Hieraciifoliae.

1. Blumea fistulosa (Roxb.) Kurz
n = 20 (ARD 164)

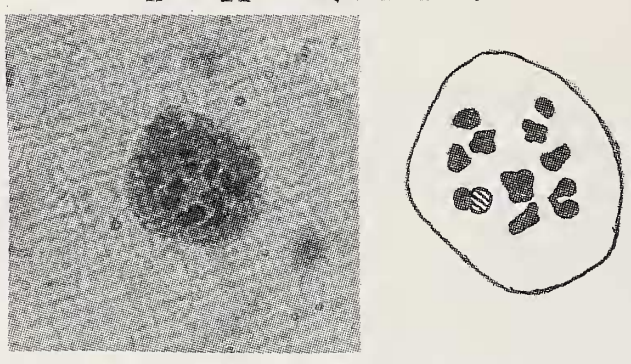


2. Blumea sessiliflora Decsne.
n = 10 (ARD 221)



3. Blumea laciniata (Roxb.) DC.
n = 11 (ARD 193)

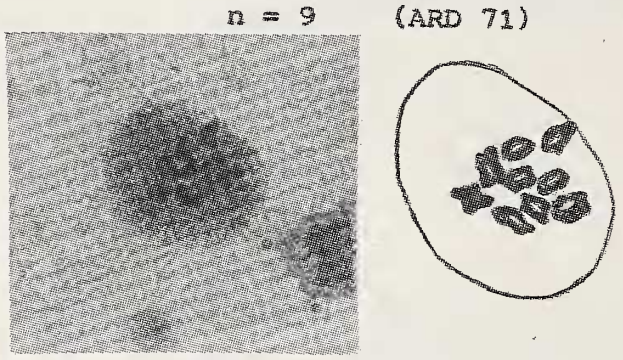
4. Blumea mollis (D.Don) Merr.
n = 11 (ARD 127)



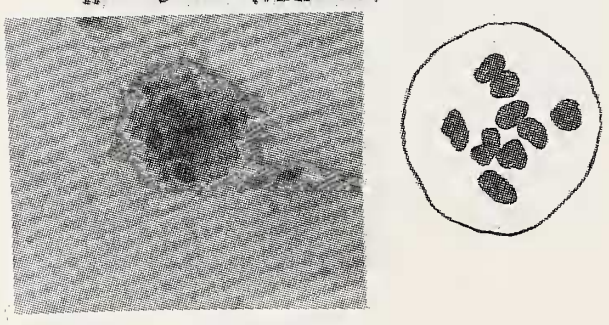
25 μ

5. Blumea lacera (Burm.f.) DC.
n = 22 (ARD 71)

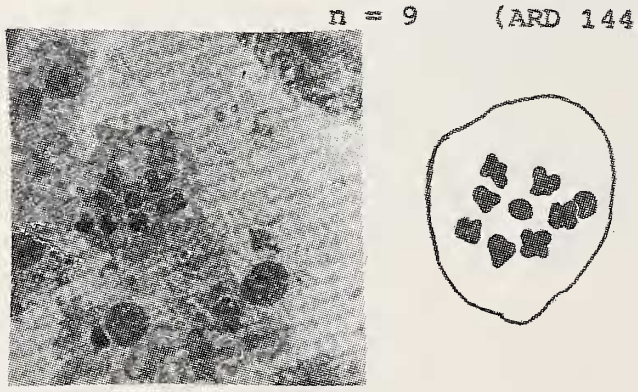
6. Blumea membranacea DC.
var. membranacea Rand.
n = 9 (ARD 71)



7. Blumea membranacea DC.
var. jacquemontii (Hk.f.) Rand.
n = 9 (ARD 99)



8. Blumea virens DC.
n = 9 (ARD 144)



Photomicrographs and Karyotype Drawings.
1-8. Section Paniculatae.

were collected mostly in fruit. There is no previous report of the chromosome number.

Specimens examined: Assam, Mowlai Forest Reserve: *ARD 241, ARD 247* (BLAT).

6. **Blumea balsamifera** (Linn.) DC., Prodr. 5: 447.1836.

Conyza balsamifera Linn. Sp. Pl. ed. 2: 1208. 1763.

Chromosome number: n = 10

Specimens examined: Assam, Shillong: *ARD 245 - 246*; Mowlai Forest Reserve: *ARD 249*. Nepal, Chatraghat: *ARD 227-228* (BLAT).

Section III. Sagittatae

This section contains one species, *Blumea sagittata* Gagnep., found only in China.

Section IV. Hieraciifoliae

Total number of species - 5.

Species found in India - 2.

Species belonging to this section are either herbs or subshrubs. The capitula occur in clusters. Phyllaries are linear-oblong. The receptacle is alveolate and glabrous or pilose. Achenes are ribbed.

7. **Blumea hieraciifolia** (D. Don) DC. *in* Wight, Contrib. Bot. Ind. 15. 1834.

Erigeron hieracifolium D. Don, Prodr. Fl. Nep. 272. 1825.

This species has four varieties, three of which occur in India - var. *hieraciifolia,* var. *macrostachya,* and var. *hamiltoni.* The chromosome number has been worked out for only one of these varieties.

var. **macrostachya** (DC.) Hook.f., Fl. Brit. India 3: 263. 1882.

Chromosome number: n = 18 (Previously reported - 2n = 48, Ching-I Peng and Chien-Chang Hsu from Taiwan).

Specimens examined: Assam, Shillong: *ARD 238, ARD 240 - 241, ARD 247 - 248* (BLAT).

8. **Blumea clarkei** Hook.f., Fl. Brit. India 3: 267. 1882.

Chromosome number: n = 10

Specimens examined: N. Kanara: *ARD 151-153, ARD 215-220* (BLAT).

Section V. Paniculatae

Total number of species - 11.

Species found in India - 9.

Species belonging to this section are herbs. Capitula occur in panicles or glomerules. Phyllaries are linear. The receptacle is alveolate and glabrous or pubescent. Achenes may or may not be ribbed.

9. **Blumea fistulosa** (Roxb.) Kurz, Jour. As. Soc. Bengal 46 (2): 187. 1877.

Conyza fistulosa Roxb., Fl. Ind. 3: 429. 1832.

Chromosome number: n = 20 (Previously reported - 2n = 30, R.C. Gupta and B.S. Gill from Madhya Pradesh; n = 9, Abraham Mathew and P.M. Mathew from Kerala).

Specimens examined: Madhya Pradesh, Umaria-Khappa: *ARD 162 - 166*. East Nepal: *ARD 229-230* (BLAT)

10. **Blumea sessiliflora** Decaisne, Nouv. Ann. Mus. Par. 3: 140. 1834.

Chromosome number: n = 10

Specimens examined : Karnataka, Castlerock and N. Kanara: *ARD 113, ARD 123-124, ARD 211-212, ARD 221* (BLAT).

11. **Blumea laciniata** (Roxb.) DC., Prodr. 5: 436. 1836.

Conyza laciniata Roxb., Fl. Ind. 3: 428. 1832.

Chromosome number: n = 11 (Previously reported - n = 11, Remananden from West Himalayas, 2n = 18, Ching-I Peng and Chien-Chang Hsu from Taiwan).

Specimens examined: Assam, Shillong: *ARD 242, ARD 244*. Gujarat, Dahanu: *ARD 190-196*. Karnataka, N. Kanara: *ARD 159-160.* E. Nepal: *ARD 232* (BLAT).

12. **Blumea mollis** (D. Don) Merr., Philipp. Jour. Sci. (Bot.) 5: 395. 1910.

Erigeron molle D. Don, Prodr. Fl. Nep. 172. 1825.

Chromosome number: n = 10 or 11 (Previously reported - n = 11, Remananden from Nilgiri Hills; n = 11, L.S. Gill and A.M. Abubakar from Tanzania; n = 9 + 1-2, Abraham Mathew and P.M. Mathew from Kerala).

Specimens examined: Maharashtra, Bombay: *ARD 14-15, ARD 68-69, ARD 200*; Khandala: *ARD 45*; Koyna: *ARD 24*; Mahableshwar: *ARD 64*; Matheran: *ARD 31, ARD 71.* Karnataka, Belgaum: *ARD 135*; Castlerock: *ARD 226.* Gujarat, Baroda: *ARD 104-106;* Dahanu: *ARD 187-188.* Madhya Pradesh, Nagpur: *ARD 170, ARD 172* (BLAT).

13. **Blumea lacera** (Burm.f.) DC. *in* Wight, Contrib. Bot. Ind. 14. 1834.

Conyza lacera Burm.f., Fl. Ind. 180, t. 59, f. 1. 1768.

Chromosome number: n = 22 (Previously reported - n = 9, Patil and Kamble from W. Bengal; 2n = 36, Ching-I Peng and Chien-Chang Hsu from Taiwan).

Specimens examined: Maharashtra, Lonavla: *ARD 81.* Karnataka, Castlerock: *ARD 117-122, ARD 129, ARD 138, ARD 222.* Gujarat, Dangs: *ARD 178-179.* Nepal: *ARD 223-224, ARD 235-237* (BLAT)

14. **Blumea membranacea** DC., Prodr. 5: 440. 1836.

Conyza membranacea Wall., Cat. no. 3019, comp. no. 129. 1831 *n.n.*

Chromosome number: n = 9

(Previously reported - n = 22, Remananden from Kerala; 2n=18, Abraham Mathew and P.M. Mathew from Tamil Nadu).

Specimens examined: Maharashtra, Borivli National Park: *ARD 17*; Elephanta Island: *ARD 35-37*; Khandala: *ARD 49*; Lonavla: *ARD 79*; Mahableshwar: *ARD 29*, ARD 63; Matheran: *ARD 32, ARD 71.* Madhya Pradesh, Nagpur: *ARD 171, ARD 173*; Tamia: *ARD 154-155, ARD 158* (BLAT).

var. **jacquemontii** (Hook.f.) Randeria, Blumea 10 (1): 271. 1960.

Blumea jacquemontii Hook.f., Fl. Brit. India 3: 265. 1882.

Chromosome number: n = 9

Specimens examined: Rajasthan, Mount Abu: *ARD 91-99* (BLAT).

15. **Blumea virens** DC. *in* Wight, Contrib. Bot. Ind. 14. 1834.

Conyza virens Wall., Cat. no. 3037, comp. no. 147. 1831 *n.n.*

Chromosome number: n = 9

Specimens examined: Karnataka, Castlerock: *ARD 125-126*; N. Kanara: *ARD 139-140, ARD 144-145, ARD 148-150* (BLAT).

Section VI. Oxyodontae

Total number of species - 4.

Species found in India - 4.

Species belonging to this section are pubescent herbs which may be erect or prostrate. Capitula are arranged in axillary and terminal clusters or panicles. Outer phyllaries are linear. The receptacle is glabrous and alveolate. Achenes are not ribbed.

16. **Blumea belangeriana** DC., Prodr. 5: 444. 1836.

Chromosome number: n = 10

Specimens examined: Gujarat, Dangs: *ARD 181*; Junagadh: *ARD 66.* Karnataka, Castlerock: *ARD 128*; Jog Falls: *ARD 141.* Maharashtra, Khandala: *ARD 48*; Matheran: *ARD 30, ARD 72, ARD 75* (BLAT).

17. **Blumea malcolmii** (Clarke) Hook.f., Fl. Brit. India 3: 266. 1882.

Pluchea malcolmii Clarke, Comp. Ind. 95. 1876.

Chromosome number: Only one specimen was collected and no count could be made. (Previously reported - 2n=18, Abraham Mathew and P.M. Mathew from Kerala).

Specimen examined: Maharashtra, Mahableshwar: *ARD 28* (BLAT).

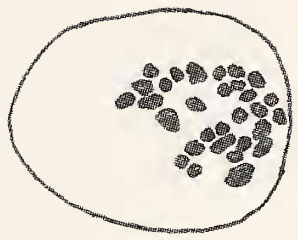
18. **Blumea eriantha** DC. *in* Wight, Contrib. Bot. Ind. 15. 1834.

Chromosome number: n = 30 (Previously reported - 2n = 20, Amthul Shukur, K.N. Narayan and C. Shantamma from Karnataka).

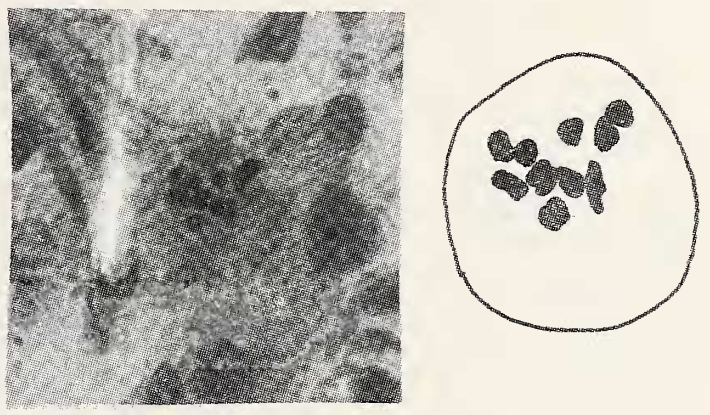
Specimens examined: Include both fertile plants with well-developed anthers and sterile ones with abortive anthers.

Fertile: Gujarat, Baroda: *ARD 185.* Maharashtra, Bombay: *ARD 5-6*; Lonavla: *ARD 80*; Mahableshwar *ARD 50-51, ARD 62, ARD 65, ARD 202-204*; Matheran: *ARD 33, ARD 70, ARD 82*; Nagpur: *ARD 176* (BLAT).

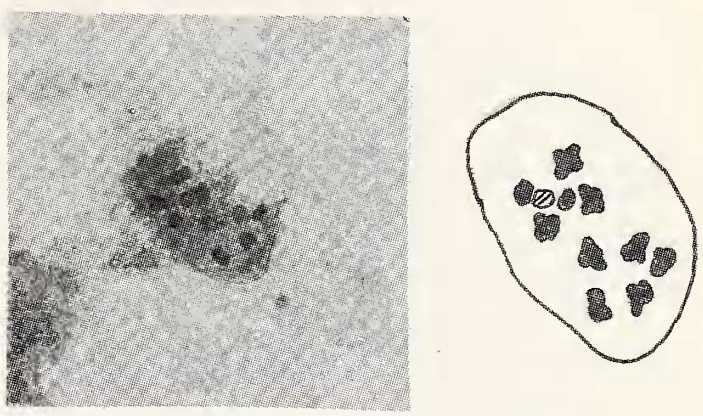
1. Blumea belangeriana DC.
n = 10 (ARD 181)



2. Blumea eriantha DC.
n = 30 (ARD 202)

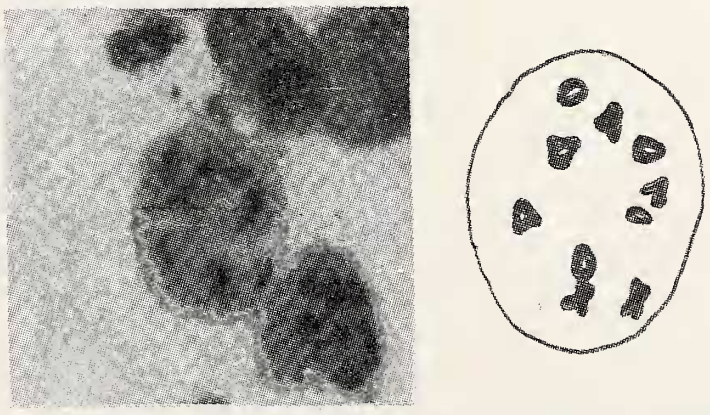


3. Blumea oxyodonta DC.
n = 10 (ARD 202)

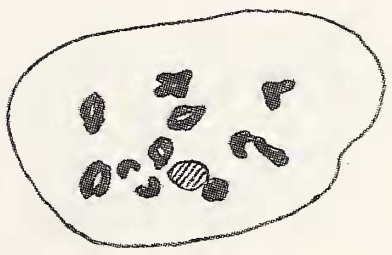


4. Blumea obliqua (Linn.) Druce
n = 10 (ARD 183)

25 μ



5. Laggera aurita (Linn.f.) Sch.-Bip.
n = 10 (ARD 132)



6. Nanothamnus sericeus T.Thoms
n = 10 (ARD 197)

Photomicrographs and Karyotype Drawings.
1-3. Section Oxyodontae; 4. Section Dissitiflorae; 5. *Laggera*; 6. *Nanothamnus.*